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(71) Applicant: 000194918
Hosiden Corporation
1-4-33 Kitakyuhoji-machi, Yao-shi, Osaka

(72) Inventor: Yasuhiro Komatsu
% Hosiden Corporation
1-4-33 Kitakyuhoji-machi, Yao-shi, Osaka

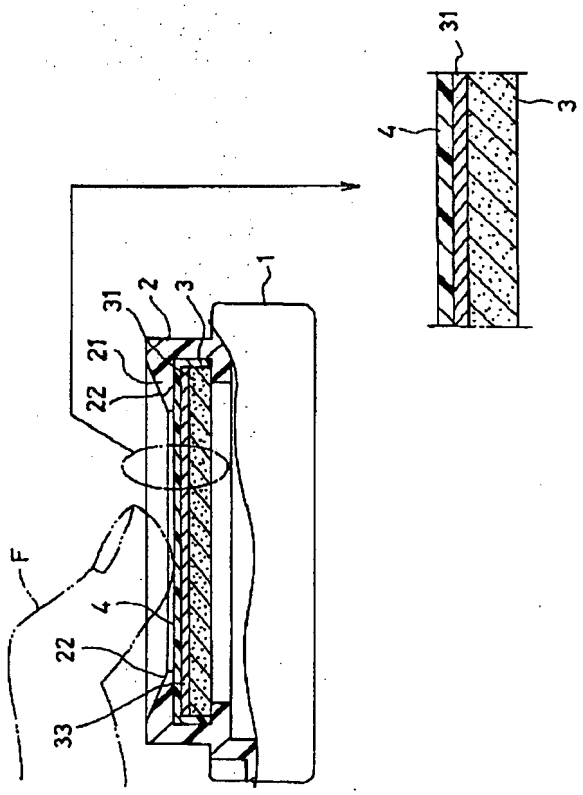
(74) Agent: Koichi Suzue, Patent Attorney

(54) [Title of the Invention] Structure of a Touch-Sensitive Control for a Touch-Sensitive Coordinate Input Device

(57) [Abstract]

[Object] To improve the ease of use in the structure of a touch-sensitive control for a touch-sensitive coordinate input device whereby the operator may move a cursor upon a display screen by using a finger to press upon an electrically insulating layer and thus press down on four surface electrodes corresponding to the X axis and Y axis of the display, or move over the electrically insulating layer.

[Constitution] [The invention] comprises four surface electrodes 31, 32, 33 and 34 provided in an electrode plate, thus forming a touch-sensitive operation area surrounded by a rim member 2, and an inclined surface 22 provided upon the rim member 2.



[Claims]
[Claim 1]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device comprising: an electrode plate having four surface electrodes which are separated in a circumferential direction and electrically insulated from each other, said surface electrodes abutting each other in a center portion of said electrode plate; an electrically insulting layer overlaid on said electrode plate so as to cover said four surface electrodes, a surface of said electrically insulating layer being to be touched with a finger of an operator; and a rim member provided with an inclined face which forms a touch-sensitive operation area of said four surface electrodes in a peripheral portion of said electrode plate on which said electrically insulating layer is overlaid, said inclined face being upgrade toward an outer peripheral side and being continuous to said touch-sensitive operation area.

[Claim 2]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 1, wherein said rim member protrudes from a case having a wiring board on which various electric components and electronic components are mounted.

[Claim 3]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device comprising: an electrode plate having four surface electrodes which are separated in a circumferential direction and electrically insulated from each other, said surface electrodes abutting each other in a center portion of said electrode plate, a surface of said electrode plate protruding in a dome shape from a peripheral portion to the center portion thereof, together with said four surface electrodes; an electrically insulting layer overlaid on said electrode plate so as to cover said four surface electrodes, a surface of said electrically insulating layer being to be touched with a finger of an operator; and a rim member which forms a touch-sensitive operation area of said four surface electrodes in the peripheral portion of said electrode plate on which said electrically insulating layer is overlaid.

[Claim 4]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 1 or claim 3, wherein said four surface electrodes abut each other so that, when the operator puts the finger on the center portion of said electrode plate having said four surface electrodes, the finger overlaps said four surface electrodes via said electrically insulating layer, and said touch-sensitive operation area is of a size enabling an extra area to be formed around the finger for allowing the finger to move.

[Claim 5]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 1 or claim 3, wherein a case to which said rim member is provided incorporates a wiring board on which various electric components and electronic components are mounted, and a press open/close switch, a connection condition of said switch being alternatingly switched over between an open state and a closed state by each press of an operation portion, and said electrode plate covered by said electrically insulating layer is accommodated in said case in a state where said electrode plate is capable of being pressed in and restored from the pressing with respect to said case and always elastically urged along a restoring direction, pressing and restoring operations of said operation portion of said switch being interlocked with pressing and restoring operations of said electrode plate.

[Claim 6]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device comprising: a sphere which is rotatably held in a base member; an electrode plate having an opening which is fitted to said sphere so that a part of said sphere protrudes on a surface side, said electrode plate having four surface electrodes which are separated in a circumferential direction and electrically insulated from each other, said surface electrodes abutting each other in a periphery of said opening; and an electrically insulting layer having an opening which is fitted to said sphere so that a part of said sphere protrudes on the surface side, said electrically insulating layer being overlaid on said electrode plate so as to cover said four surface electrodes, a surface of said electrically insulating layer being to be touched with a finger of an operator.

[Claim 7]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 6, wherein a peripheral portion of said opening of said electrically insulating layer which is fitted to said sphere overlaps a surface of said sphere.

[Claim 8]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 6, further comprising a rim member for forming a touch-sensitive operation area of said four surface electrodes in a peripheral portion of said electrode plate which is covered by said electrically insulating layer.

[Claim 9]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 8, wherein said rim member has an inclined face which is upgrade toward an outer peripheral side and is continuous to said touch-sensitive operation area.

[Detailed Description of the Invention]
[0001]
[Industrial Field of Utilization]

The present invention relates to the structure of a touch-sensitive control for a touch-sensitive coordinate input device in which an electrode plate having four surface electrodes is pressed by an operator with the operator's finger via an electrically insulating layer or the operator moves the finger on the electrically insulating layer, whereby a coordinate signal can be varied based on variations of electrostatic capacitances between the operator's finger and the four surface electrodes.

[0002]
[Prior Art]

Japanese National Patent Publication No. 4-507316 describes a touch-sensitive coordinate input device. The touch-sensitive coordinate input device has a function which is similar to that implemented by a mouse functioning as a versatile coordinate input device. According to the touch-sensitive coordinate input device, the cursor position on a display screen can be varied based on the position of a finger of the operator. The publication may disclose that signals output in accordance with variations of electrostatic

capacitances between the operator's finger and a number of surface electrodes are synthesized so that the output signal is converted into a signal indicative of a cursor position on the display screen. However, the publication discloses nothing about measures for improving the operability of such a touch-sensitive coordinate input device, and reducing the size and thickness of the device.

[0003]

[Problem to be Solved by the Invention]

The present invention came about in view of the aforementioned circumstances. It is an object of the present invention to improve the structure of a touch-sensitive control for a touch-sensitive coordinate input device, thereby enhancing the operability of the touch-sensitive coordinate input device. It is another object to easily realize a reduced size and a reduced thickness of the touch-sensitive coordinate input device.

[0004]

[Means of Solving the Problem]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 1 of the present invention comprises: an electrode plate having four surface electrodes which are separated in a circumferential direction and electrically insulated from each other, said surface electrodes abutting each other in a center portion of said electrode plate; an electrically insulting layer overlaid on said electrode plate so as to cover said four surface electrodes, a surface of said electrically insulating layer being to be touched with a finger of an operator; and a rim member provided with an inclined face which forms a touch-sensitive operation area of said four surface electrodes in a peripheral portion of said electrode plate on which said electrically insulating layer is overlaid, said inclined face being upgrade toward an outer peripheral side and being continuous to said touch-sensitive operation area. In addition, as described in claim 2 of the present invention, it is preferable that the rim member protrudes from a case having a wiring board on which various electric components and electronic components are mounted.

[0005]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 3 of the present invention comprises: an electrode plate having four surface electrodes which are separated in a circumferential direction and electrically insulated from each other, said surface electrodes abutting each other in a center portion of said electrode plate, a surface of said electrode plate protruding in a dome shape from a peripheral portion to the center portion thereof, together with said four surface electrodes; an electrically insulting layer overlaid on said electrode plate so as to cover said four surface electrodes, a surface of said electrically insulating layer being to be touched with a finger of an operator; and a rim member which forms a touch-sensitive operation area of said four surface electrodes in the peripheral portion of said electrode plate on which said electrically insulating layer is overlaid.

[0006]

Moreover, in the structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 1 or claim 3, as described in claim 4 of the present invention, it is preferable that said four surface electrodes abut each other so that, when the operator puts the finger on the center portion of said electrode plate having said four surface electrodes, the finger overlaps said four surface electrodes via said electrically insulating layer, and said touch-sensitive operation area is of a size enabling an extra area to be formed around the finger for allowing the finger to move, and as described in claim 5 of the present invention, it is preferable that a case to which said rim member is provided incorporates a wiring board on which various electric components and electronic components are mounted, and a press open/close switch, a connection condition of said switch being alternatingly switched over between an open state and a closed state by each press of an operation portion, and said electrode plate covered by said electrically insulating layer is accommodated in said case in a state where said electrode plate is capable of being pressed into and restored from the pressing with respect to said case and always elastically urged along a restoring direction, pressing and restoring operations of said operation portion of said switch being interlocked with pressing and restoring operations of said electrode plate.

[0007]

The structure of a touch-sensitive control for a touch-sensitive coordinate input device according to claim 6 of the present invention comprises: a sphere which is rotatably held in a base member; an electrode plate having an opening which is fitted to said sphere so that a part of said sphere protrudes on a surface side, said electrode plate having four surface electrodes which are separated in a circumferential direction and electrically insulated from each other, said surface electrodes abutting each other in a periphery of said opening; and an electrically insulting layer having an opening which is fitted to said sphere so that a part of said sphere protrudes on the surface side, said electrically insulating layer being overlaid on said electrode plate so as to cover said four surface electrodes, a surface of said electrically insulating layer being to be touched with a finger of an operator. In addition, in such a structure of a touch-sensitive control, it is preferable that, as in the invention according to claim 7, a peripheral portion of said opening of said electrically insulating layer which is fitted to said sphere overlaps a surface of said sphere. In addition, as in the invention according to claim 8, it is possible to adopt a constitution further comprising a rim member for forming a touch-sensitive operation area of said four surface electrodes in a peripheral portion of said electrode plate which is covered by said electrically insulating layer. In this case, as in the invention according to claim 9, it is preferable to adopt a constitution wherein said rim member has an inclined face which is upgrade toward an outer peripheral side and is continuous to said touch-sensitive operation area.

[0008]

[Operation]

With the inventions according to claims 1–9 of the present invention, among the four surface electrodes separated in a circumferential direction, predetermined two surface electrodes at alternate positions are assigned a plus coordinate and a minus coordinate, respectively, in the X-axis direction of a display screen. The remaining two surface electrodes are assigned a plus coordinate and a minus coordinate, respectively, in the Y-axis direction of the display screen. The center portion of the electrode plate in which the four surface electrodes abut each other is assigned to the origin, i.e., the coordinates [0, 0]. In the case where the operator operates the

touch-sensitive control with the operator's finger in such a condition, it is advantageous that the position of the origin and the touch-sensitive operation area can be clearly recognized without requiring for the operator to see them (hereinafter, referred to as a blind operability). Moreover, it is desired that any probability that the finger is accidentally slipped off from the touch-sensitive operation area can be eliminated (hereinafter, referred to as a slip-off preventing property), and that an operability for allowing the finger to be repetitively moved within the touch-sensitive operation area (hereinafter, referred to as a finger repetitive operability) is excellent. If these properties are superior, the operability of the touch-sensitive control is judged to be good.

[0009]

In terms of the above-mentioned properties, with the invention according to claim 1 in which the touch-sensitive operation area is formed by the rim member, the operator can easily recognize the limit edge of the touch-sensitive operation area when the operator's finger hits the rim member, so that the blind operability is improved. Since the rim member has an inclined face which is formed continuously to the touch-sensitive operation area and is upgrade toward the outer peripheral side, the blind operability is further improved, and also the repetitive movement of the finger can easily be performed, because the returning movement of the finger to the touch-sensitive operation area after the finger is slipped on the inclined face is naturally supported by the upgrade face. Accordingly, a good finger repetitive operability is attained. Moreover, the inclined face is useful for preventing the finger from being slipped off from the touch-sensitive operation area, so that the slip-off preventing property is also improved.

[0010]

With the invention according to claim 2, the rim member preferably protrudes from a case incorporating a wiring board on which various electric components and electronic components are mounted. With such a construction, the whole structure can be flat. This is useful for reducing the size and the thickness of the touch-sensitive control.

[0011]

With this invention, the top point of the electrode plate which protrudes in a dome shape is assigned to the origin of the coordinates, so that the origin can easily be recognized by the touch with a finger. In addition, when the finger hits the rim member, the operator can easily recognize the limit edge of the touch-sensitive operation area, so that the blind operability is improved.

[0012]

With the invention according to claim 4, the range in which the cursor can be moved on the display screen can easily be widened, and the cursor can be moved on the display screen based on the variation of electrostatic capacitances by the change of pressing pressure of the finger against the surface electrodes. Moreover, it is possible to easily perform the operation for moving the cursor by a small distance on the display screen by pressing the electrically insulating layer with the finger or by tilting the finger on the electrically insulating layer.

[0013]

With the invention according to claim 5, the open/closed state of the press open/close switch can be changed by depressing the electrode plate with a finger, so that the determining operation of the cursor position on the display screen can be performed directly by the finger which is used for controlling the movement of the cursor (a pointer function).

[0014]

With the invention according to claim 6, the action of the finger for rotating the sphere results naturally in the action for moving the finger on the electrically insulating layer. Moreover, the sphere is rotated by the movement of the finger, so that the operation for moving the finger in a very small area can be smoothly and easily performed. Since the sphere protrudes from the opening of the electrically insulating layer, the origin of the coordinates can easily be recognized by tactilely recognizing the sphere with the finger.

[0015]

With the invention according to claim 7, the peripheral portion of the opening of the electrically insulating layer which overlaps the surface of the sphere is useful for preventing the sphere from falling out of the base member.

[0016]

In the same manner as explained for the invention according to claim 1, with the invention according to claim 8, the blind operability is improved, and also excellent finger repetitive operability and slip-off preventing property can be attained. With the invention according to claim 9, not only can the blind operability be improved, but good finger repetitive operability and good slip-off prevention can be achieved.

[0017]

[Preferred Embodiment]

Fig. 1 is a schematic perspective view showing a touch-sensitive control A for a touch-sensitive coordinate input device of a first embodiment of the invention; Fig. 2 is a diagram illustrating a sensitive operation area 3 formed in the touch-sensitive control of the first embodiment; Fig. 3 is a schematic side view in which a part of the touch-sensitive control A of Fig. 1 is cut away and shown in an enlarged manner.

[0018]

In Fig. 1, 1 designates a hollow case made of a synthetic resin molded body. The case 1 takes a rectangular parallelepiped form having a width and a length of 33 mm, respectively, and a height of about 13 mm. The case 1 incorporates a wiring board (not shown) on which various electric components and electronic components for forming required circuits such as a signal synthesizing circuit, and an output circuit are mounted. On a side face of the case 1, a terminal 12 for interface is provided. From the upper face of the case 1, a rim member 2 having a low columnar shape protrudes as a unit. As shown in Fig. 3, the rim member 2 incorporates a circular electrode plate 3. A ring-shaped protrusion part 21 which is integrated with the rim member 2 is superposed on a peripheral portion of the electrode plate 3. The protrusion part 21 forms a circular touch-sensitive operation area 10 in the electrode plate 3.

[0019]

The electrode plate 3 comprises four surface electrodes 31, 32, 33, and 34 which are separated in a circumferential direction and electrically insulated from each other. Each of the surface electrodes 31 to 34 has a sector form which becomes gradually narrower as moving toward the center portion of the electrode plate 3. The surface electrodes 31 to 34 are arranged in such a manner that they abut each other in

the center portion. Between the four surface electrodes 31 to 34, gaps 35, 36, 37, and 38 for electric insulation are ensured. An electrically insulating sheet 4 is overlaid on the electrode plate 3 so as to cover the four surface electrodes 31 to 34. The operator presses the surface electrodes 31 to 34 with operator's finger via the electrically insulating sheet 4, or moves the finger on the electrically insulating sheet 4.

[0020]

In the rim member 2, the ring-shaped protrusion part 21 which forms the sensitive operation area 10 is provided with an inclined face 22 (a tapered face) which is continuous to the sensitive operation area 10. The inclined face 22 is upgrade toward the outer peripheral side.

[0021]

In the touch-sensitive control A, when the operator puts a finger F on the electrically insulating sheet 4 in the center portion of the electrode plate 3, the finger F overlaps the four surface electrodes 31 to 34 via the electrically insulating sheet 4. In addition, the area of the sensitive operation area 10 is sufficiently large for ensuring for the finger F some allowance for movement around the finger F which is put in the center portion of the electrode plate 3.

[0022]

In the above, the electrically insulating sheet 4 is an example of the electrically insulating layer. Preferably, for example, a polyethylene sheet can be used as the electrically insulating sheet 4. As the electrically insulating layer, it is possible to use an electrically insulating coating film which is applied to and formed on the surface of the electrode plate 3 so as to cover the surface electrodes 31 to 34.

[0023]

In the thus configured touch-sensitive control A of the touch-sensitive coordinate input device, as shown in Fig. 2, predetermined two surface electrodes 31 and 33 at alternate positions are assigned a plus coordinate and a minus coordinate, respectively, in the X-axis direction of the display screen. The remaining two surface electrodes 32 and 34 are assigned a plus coordinate and a minus coordinate, respectively, in the Y-axis direction of the display screen. The center portion O of the electrode plate 3 in which the four surface electrodes 31 to 34 abut each other is assigned an origin, i.e., the coordinates [0, 0].

[0024]

With this construction, when the finger F of the operator is put on the electrode plate 3 via the electrically insulating sheet 4 as shown in Fig. 3, electrostatic capacitances between the operator's finger F and the surface electrodes 31 to 34 are varied depending on the overlap areas of the finger over the respective surface electrodes 31 to 34. Accordingly, by synthesizing the signals output from the individual surface electrodes 31 to 34 when a finger is put thereon, a cursor can be moved on the display screen in the X-axis and Y-axis directions.

[0025]

In the case where the operator puts the operator's finger F on the electrically insulating sheet 4 and moves the finger in a direction in which the operator wants to move the cursor, when the finger F hits the protrusion part 21 of the rim member 2, the operator can tactilely recognize that the position is the edge position of the sensitive operation area 10. This structure allows the operator to desirably move the cursor on the display screen by moving the finger F in the sensitive operation area 10 in a desired direction without requiring the operator to see the sensitive operation area 10. In the case where the operator repeatedly and continuously drags the finger F within the sensitive operation area 10 so as to move the cursor on the display screen in a wide range, the finger F is moved so as to draw an oval path. In this embodiment, the rim member 2 is provided with the inclined face 22 which is continuous to the sensitive operation area 10 and upgrade toward the outer peripheral side, so that the repetitive movement of the finger F is easily attained with the aid of the inclined face 22. Moreover, the rim member 2 is useful for preventing the finger F from slipping off from the sensitive operation area 10 during the operation in which the operator performs the operation without seeing the input device, i.e., during a so-called blind touch operation.

[0026]

In addition, since the sensitive operation area 10 has an area which is sufficiently large for allowing the finger F to be moved, it is easy to widen the range in which the cursor is moved on the display screen by moving the finger F, and it is easy to move the cursor by a small distance on the display screen by pressing the electrically insulating layer 4 with the finger F or by tilting the finger F on the electrically insulating layer 4 so as to change the above-mentioned overlap area.

[0027]

A second embodiment will be described with reference to Fig. 7. The second embodiment utilizes the fundamental structure of the touch-sensitive control A which has been described in the first embodiment, and the touch-sensitive control A is provided with a pointer function.

[0028]

In the second embodiment, the case 1 incorporates a wiring board P on which various electric components and electronic components for forming required circuits such as a signal synthesizing circuit, and an output circuit, and a depression open/close type switch 5. The connection condition of the switch 5 is alternatingly switched over between the open state and the closed state by each depression of an operation portion 51. The electrode plate 3 which is covered by the electrically insulating sheet 4 can be depressed into and restored from the inside of the rim member 2 with respect to the case 1, and the electrode plate 3 is always elastically urged in the restoring direction by means of a spring 6. The depression and restoring operations of the operation portion 51 of the switch 5 are interlocked with those of the electrode plate 3.

[0029]

According to the second embodiment, when the finger is moved on the electrically insulating sheet 4 and the electrode plate 3 is then depressed by this finger, the operation portion 51 of the switch 5 is depressed in a manner interlocked with the depression operation, so that the open/closed state of the switch 5 is switched over. Thus, the touch-sensitive control A is provided with a pointer function by which the determining operation of the cursor position on the display screen can be performed directly by the finger which is now used for controlling the movement of the cursor.

[0030]

The other constructions and functions of the touch-sensitive control A shown in Fig. 7 are the same as those described in the first embodiment. Therefore, identical

reference numerals are used for designating identical components, and their detailed description is omitted.

[0031]

A third embodiment will be described with reference to Fig. 4. The touch-sensitive control A of the third embodiment comprises a case 1 which takes a rectangular parallelepiped form for enabling the operator to hold the device with hands. A square sensitive operation area 10 is formed by a rim member 2 which is formed as a part of the case 1. On the sides of the sensitive operation area 10, a push button 52 for a cancel switch, and a push button 53 for a determination switch are disposed, respectively. Such a touch-sensitive control A is preferably used for, for example, video games. The reference numeral 54 designates a plug for interface. The other constructions and functions of the touch-sensitive control A shown in Fig. 4 are the same as those described in the first embodiment.

[0032]

A fourth embodiment will be described with reference to Figs. 5 and 6. Fig. 5 is a schematic perspective view of a touch-sensitive control of a fourth embodiment; and Fig. 6 is a view illustrating an operation of the touch-sensitive control of the fourth embodiment. In the touch-sensitive control A shown in these figures, the surface of an electrode plate 3 including four surface electrodes 31 to 34 (the electrode face 32 is not shown) protrudes from the peripheral portion to the center portion, so as to have a dome shape. A rim member 2 forms a circular sensitive operation area 10. The other constructions, for example, the construction wherein the electrode plate comprises four plates which are separated in a circumferential direction and electrically insulated from each other, that wherein the surface electrodes are arranged so as to abut each other in the center portion (the top portion) of the electrode plate 3, and that wherein an electrically insulating sheet is overlaid on the electrode plate 3 so as to cover the four surface electrodes are the same as those of the first embodiment.

[0033]

According to the touch-sensitive control A, the top point of the electrode plate 3 which protrudes in a dome shape is assigned to the origin of the coordinates, so that the origin can readily be recognized by an operator's finger F. In addition, when the finger hits the rim member 2, the operator can readily recognize the limit edge of the sensitive operation area 10. The other constructions and functions of the touch-sensitive control A shown in Figs. 5 and 6 are the same as those described in the first embodiment.

[0034]

A fifth embodiment will be described with reference to Figs. 8 and 9. Fig. 8 is a vertical cross section view of a touch-sensitive control of a fifth embodiment; and Fig. 9 is a plan view of the touch-sensitive control of the fifth embodiment.

[0035]

In the fifth embodiment, a sphere 7 is rotatably held in a recess portion 81 which is formed in a base member 8 made of a synthetic resin molded body. An electrode plate 3 has an opening 39 in the center portion thereof. The opening 39 is fitted to the sphere 7, so that a part of the sphere 7 protrudes on the surface side. Four surface electrodes 31 to 34 which are separated in a circumferential direction and electrically insulated from each other are arranged so as to abut each other at the periphery of the opening. An electrically insulating sheet 4 has a circular opening in the center portion thereof. The circular opening has a diameter which is smaller than that of the sphere 7. The electrically insulating sheet 4 is overlaid on the electrode plate 3 so as to cover the four surface electrodes 31 to 34, and the surface of the electrically insulating sheet 4 is to be touched with the operator's finger F. The circular opening having the diameter which is smaller than that of the sphere 7 is fitted to the sphere 7. Accordingly, a peripheral portion 41 of the opening of the electrically insulating sheet 4 overlaps the surface of the sphere 7, so that the sphere 7 is prevented from falling out of the recess portion 81 of the base member 8 by utilizing the nerve (the deflection rigidity) of the sheet 4 when it is deflected. As the electrically insulating sheet 4, a synthetic resin sheet which has a certain degree of nerve, but has not so large deflection rigidity is used, so that the revolution of the sphere 7 is smoothly performed although the peripheral portion 41 of the opening of the electrically insulating sheet 4 overlaps the sphere 7.

[0036]

In the touch-sensitive control A, if required, a rim member 2 may be provided for forming a sensitive operation area 10 of the four surface electrodes 31 to 34 in the peripheral portion of the electrode plate 3, and the rim member 2 may be provided with an inclined face 22 which is upgrade toward the outer peripheral side and continuous to the sensitive operation area 10, as shown by phantom lines in Fig. 8.

[0037]

According to the fifth embodiment, when the finger F is moved for rotating the sphere 7, the operation naturally results in the movement of the finger on the electrically insulating sheet 4. Moreover, the sphere 7 is rotated by the movement of the finger F, so that the operation for moving the finger F in a limited small area can be smoothly and easily performed. Since the sphere 7 protrudes from the opening of the electrically insulating sheet 4, the origin of the coordinates can be recognized by tactilely recognizing the sphere 7 with the finger F. The operation for rotating the sphere 7 with the finger F is the same as the ball rotating operation for a track ball which is generally used in the prior art as a coordinate input device, so that the fifth embodiment provides an operator who usually uses a track ball with an advantage that the operation of the touch-sensitive control A is not unfamiliar.

[0038]

In the touch-sensitive controls A of the embodiments described above, for example, an AC voltage of 125 kHz is applied to each of the four surface electrodes 31 to 34. In such a case, when the operator's finger F is put on the surface electrodes 31 to 34 via the electrically insulating sheet 4, voltages of the individual surface electrodes 31 to 34 are changed depending on the areas of the surface electrodes 31 to 34 covered by the finger F. The voltages are taken out of the surface electrodes 31 to 34 as signals, and the signals are processed by a so-called microcomputer, whereby the movement of the cursor on the display screen is caused to follow the movement of the finger F. In this case, for example, the changes of voltages at the surface electrodes 31 to 34 are read by a sampling rate of 50 msec, and the position of the cursor corresponding to the X and Y coordinates on the display screen which reflect the movement of the finger F is

calculated. Based on the calculated cursor position, the cursor can be moved. When such a control method is employed, for example in the touch-sensitive control A of the first embodiment described with reference to Fig. 1, the sensitive operation area 10 may have an area approximately equal to that of the Japanese 1-yen coin (the diameter is about 20 mm). Even in such a case, the resolutions of 100 to 150 counts in both the X-axis and Y-axis directions can be attained. Thus, the cursor moving range can be made very wide without requiring for the operator to largely move the finger.

[0039]

[Meritorious Effects of the Invention]

With the inventions according to claims 1–9 of the present invention, the blind operability, slip-off preventing property and finger repetitive operability when the operator operates the touch-sensitive control with their finger is improved, and thus it is possible to provide a touch-sensitive control for a touch-sensitive coordinate input device with superior ease of use can be provided. In particular, with the invention according to claim 1, the rim member which forms the touch-sensitive operation area has an inclined face which is formed continuously to the touch-sensitive operation area and is upgrade toward the outer peripheral side, so the repetitive movements of the finger can easily be performed as a meritorious effect.

[0040]

With the invention according to claim 2, there is a meritorious effect in that it is possible to reduce the size and the thickness of the touch-sensitive control.

[0041]

With the invention according to claim 3, there is a meritorious effect in that the top point of the electrode plate which protrudes in a dome shape is assigned to the origin of the coordinates, so that the origin can easily be recognized with a finger.

[0042]

With the invention according to claim 4, there are meritorious effects in that the range in which the cursor can be moved on the display screen can easily be widened, and the cursor can be moved on the display screen based on the variation of electrostatic capacitances by the change of pressing pressure of the finger against the surface electrodes. Moreover, it is possible to easily perform the operation for moving the cursor by a small distance on the display screen by pressing the electrically insulating layer with the finger or by tilting the finger on the electrically insulating layer.

[0043]

With the invention according to claim 5, there are meritorious effects in that the open/closed state of the press open/close switch can be changed by depressing the electrode plate with a finger, so that the determining operation of the cursor position on the display screen can be performed directly by the finger which is used to implement a pointer function.

[0044]

With the invention according to claim 6, there are meritorious effects in that the action of the finger for rotating the sphere results naturally in the action for moving the finger on the electrically insulating layer. Moreover, the sphere is rotated by the movement of the finger, so that the operation for moving the finger in a very small area can be smoothly and easily performed. In addition, the origin of the coordinates can easily be recognized by tactilely recognizing the sphere with the finger.

[0045]

With the invention according to claim 7, there is a meritorious effect in that the peripheral portion of the opening of the electrically insulating layer which overlaps the surface of the sphere is useful for preventing the sphere from falling out of the base member without interfering with the rotation of the sphere.

[0046]

With the inventions according to claim 8 and claim 9, there are meritorious effects in that the rim member and inclined surface provided therewith improve the blind operability, and also excellent finger repetitive operability and slip-off preventing property can be attained.

[Brief Description of the Drawings]

[FIG. 1] This is a schematic perspective view showing a touch-sensitive control for a touch-sensitive coordinate input device of a first embodiment of the invention.

[FIG. 2] This is a diagram illustrating a sensitive operation area formed in the touch-sensitive control of the first embodiment.

[FIG. 3] This is a schematic side view in which a part of the touch-sensitive control of the first embodiment is broken and shown in an enlarged manner.

[FIG. 4] This is a schematic perspective view of a touch-sensitive control A of a third embodiment.

[FIG. 5] This is a schematic perspective view of a touch-sensitive control of a fourth embodiment.

[FIG. 6] This is a view illustrating an operation of the touch-sensitive control of the fourth embodiment.

[FIG. 7] This is a schematic vertical cross section view of a touch-sensitive control of a second embodiment.

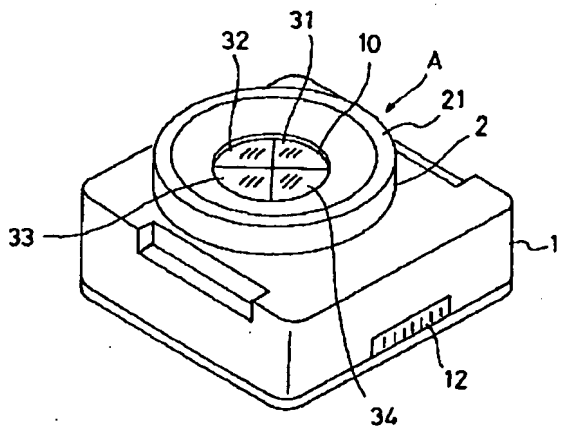
[FIG. 8] This is a vertical cross section view of a touch-sensitive control of a fifth embodiment.

[FIG. 9] This is a plan view of the touch-sensitive control of the fifth embodiment.

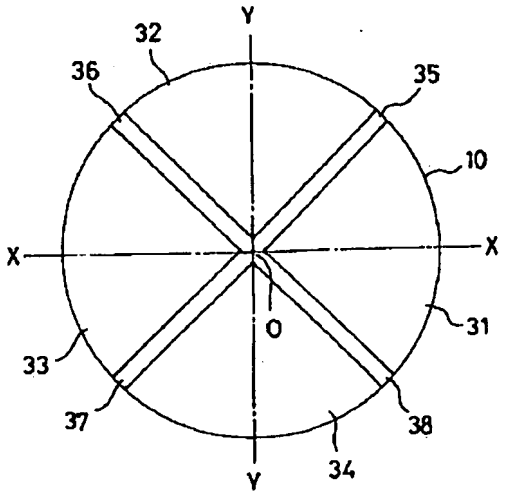
[Explanation of Symbols]

1 Case
2 Rim member
3 Electrode plate
4 Electrically insulating layer
5 Depression open/close type switch
7 Sphere
10 Touch-sensitive operation area
22 Inclined surface
31, 32, 33, 34 Surface electrodes
39 Opening in the electrode plate
41 Peripheral portion of the opening of the electrically insulating layer
P Wiring board

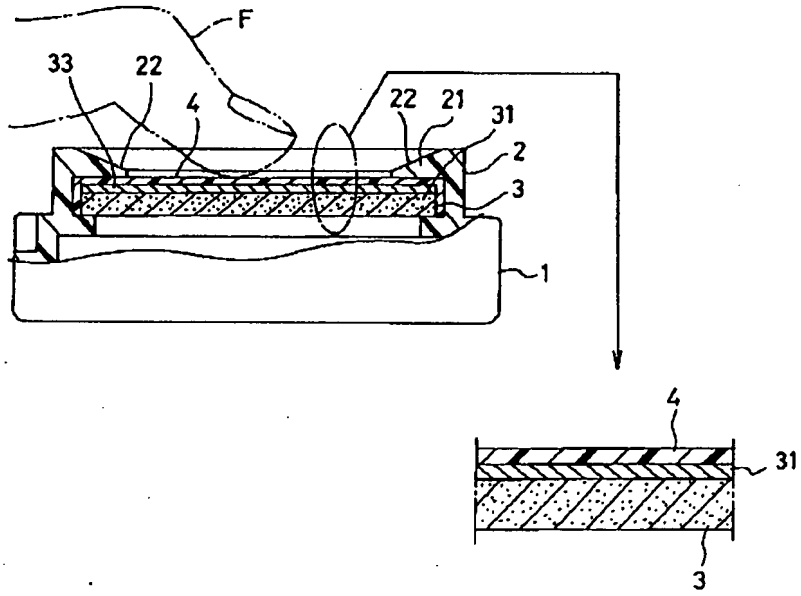
[FIG. 1]



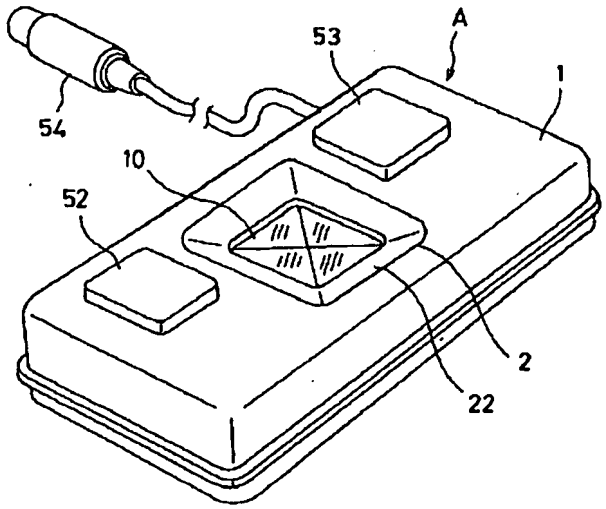
[FIG. 2]



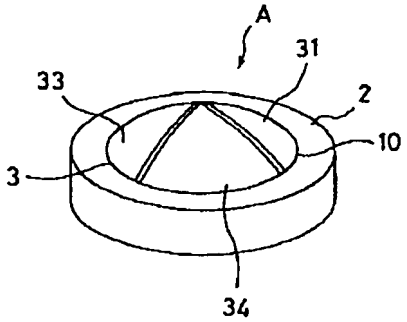
[FIG. 3]



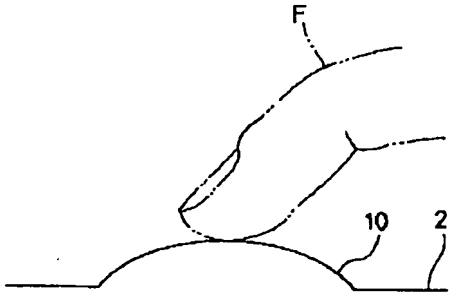
[FIG. 4]



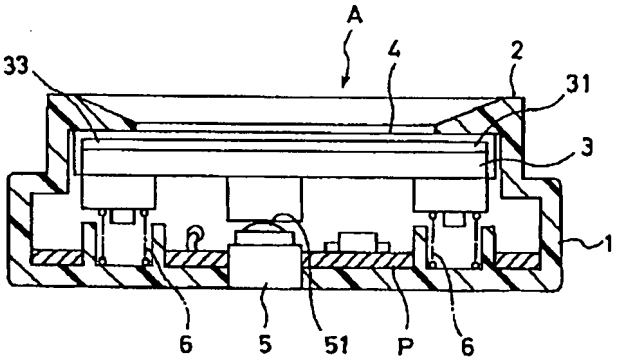
[FIG. 5]



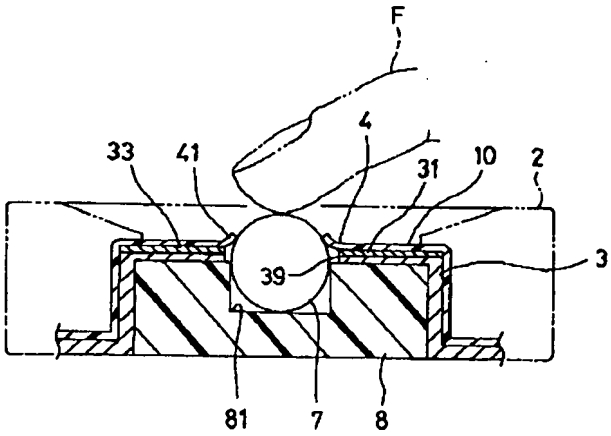
[FIG. 6]



[FIG. 7]



[FIG. 8]



[FIG. 9]